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**'PROJECT LITTLE EVA'
OPERATIONAL ENGINEERING SERVICE TEST
OF RADIO SET AN/ARC-34**

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COMMUNICATION AND NAVIGATION LABORATORY

APRIL 1954

WRIGHT AIR DEVELOPMENT CENTER

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WADC TECHNICAL REPORT 54-216

**'PROJECT LITTLE EVA'
OPERATIONAL ENGINEERING SERVICE TEST
OF RADIO SET AN/ARC-34**

*George H. Scheer
Lt Col. V. E. Redding*

Communication and Navigation Laboratory

April 1954

RDC No. 102-51

**Wright Air Development Center
Air Research and Development Command
United States Air Force
Wright-Patterson Air Force Base, Ohio**

FOREWORD

Project LITTLE EVA was initiated by ARDC as an excellent opportunity to utilize a representative number of Radio Sets AN/ARC-34, produced on preproduction implementation Contract No. AF 33(600)-16832, to determine ease of maintenance and necessary and/or desirable design changes prior to quantity production. The effort was made practicable through the cooperation of Eastern Air Defense Force, particularly McGuire Air Force Base, and AACS activities at McGuire AFB, Benton, Pennsylvania, and Highlands, New Jersey. Initiation of the project was consummated by Hq ARDC with Major H. Woolever of Hq EADF. It was notable that wholehearted cooperation was afforded in spite of the fact that the F-86D was a new aircraft type to the 4709th Defense Wing with attendant indoctrination and check-outs, the AN/ARC-34 was a new radio equipment type, the aircraft required modification, and removal of AN/ARC-27 and installation of AN/ARC-34, and, above all, normal missions had to be flown during the entire period.

A/2C S. B. Joyce was active in the pilot run at the plant of the contractor. Mr. H. J. Schmidt furnished engineering support at the site. Messrs. R. C. Sparks, C. V. Barnett and Lt Bruce Jensen monitored installation and engineering tests. Major credit is due the 4709th Defense Wing and Major F. E. Hutchins who was the coordination point in the exercise. Maintenance operations were performed by the 568th Maintenance Squadron under Major M. F. Tarr.

Credit is due the pilots who made constructive reports after flights, those who flew specially requested test missions, and to the installation and maintenance personnel without whose complete cooperation and sincere interest the project could not have been a success. Acknowledgement is made also to the initiators of the unabridged testimonials appearing in the Appendix of this report.

LITTLE EVA was in addition to bench tests, type tests, operational suitability tests, and the like. Results shown in this report, except for Appendix II, do not include the detailed findings of other tests.

ABSTRACT

Radio Set AN/ARC-34 is a subminiaturized, completely unitized UHF airborne Command Set designed by USAF for installation in premium space and all other aircraft. It is approximately 40% lighter in weight and half the size of either Radio Set AN/ARC-27 or AN/ARC-33, yet provides equal or better performance. Project LITTLE EVA was initiated in order to test the design under actual operational conditions, and to determine the ease of maintenance and adequacy of special purpose test equipment. Results of the exercise will provide information regarding necessary and desirable design changes which will be incorporated in any succeeding production equipments. This procedure will make unnecessary the majority of the costly design changes and rework programs usually associated with newly-produced electronic equipment designs. Radio Set AN/ARC-34 was installed in F-86D aircraft in place of Radio Set AN/ARC-27. Regular missions were flown as well as special test missions. Maintenance was accomplished at the site while regular maintenance personnel simultaneously were being trained. It is concluded that Radio Set AN/ARC-34 possesses size and weight advantages over Radio Sets AN/ARC-27 and AN/ARC-33, and maintenance and therefore overall cost advantages over Radio Set AN/ARC-27, while providing equal or better communications performance.

PUBLICATION REVIEW

This report has been reviewed and is approved.

FOR THE COMMANDER:



CHARLES U. BROMBACH

Colonel, USAF

Chief, Communication & Navigation Laboratory
Directorate of Laboratories

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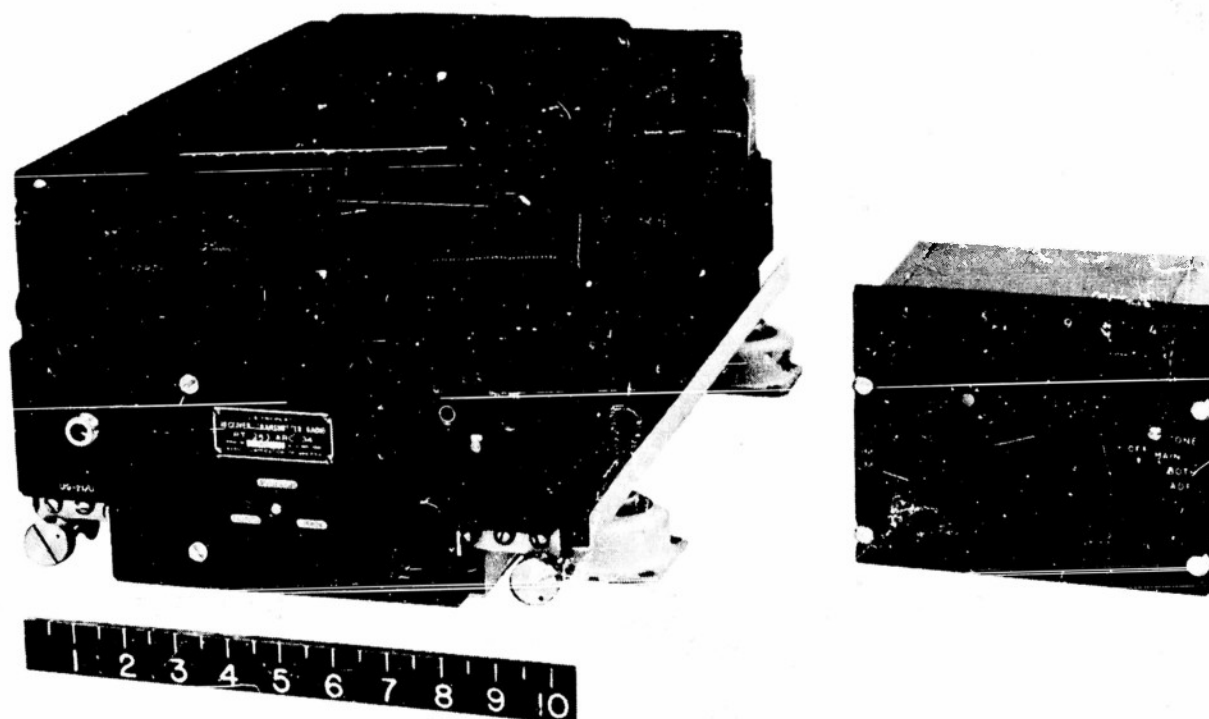


Fig. 1 RADIO SET AN/ARC-34

INTRODUCTION

UHF Command Radio Set AN/ARC-34 was standardized by Hq USAF 26 May 1952, after Operational Suitability Testing by Air Proving Ground Command*. A pre-production implementation Contract No. AF 33(600)-16832 for 147 radio sets and associated items was awarded RCA Victor Division, Camden, N. J. This small number of equipments would permit tooling for large scale production and prove the tools.

The token quantity of equipments is suitable only for special purposes where only a few equipments are involved at any one place, such as for mockups, training, etc., and not for allocation to any airplane type. WADC conceived the idea of using a sizeable portion of the equipments in order to determine from actual operating conditions what design changes should be made prior to large-scale production. Heretofore, no such opportunity has been afforded for an engineering design evaluation under actual operational use prior to full scale production and until thousands of sets have been built. Neither has the contractor had an opportunity of improving the design from a manufacturing standpoint. This always has resulted in a flood of design changes which mean field modification or rework by a contractor in order to furnish adequate, reliable and entirely satisfactory equipments to the using organizations. Design changes, minor and major, may number over a hundred on an equipment which is untried in the field, even though bench tests on a few development models have indicated engineering acceptability. Invaluable as they are, bench tests, limited special flight tests, and operational suitability tests cannot duplicate the variety of conditions which occur when many sets are installed in many aircraft and operated by many different personnel in varying situations. Furthermore, equipments produced from tools are representative of subsequent production sets whereas development samples are hand built.

Even if the radio equipment is suitable for operational flying, no evaluation of ease of maintenance can be made until the equipment has been in service use for a long period of time. This factor may be most important as it applies to special personnel training, special purpose test equipment adequacy, and the like.

* APGC Final Report on Project No. APG/ADB/41-AB, Subject: Accelerated Operational Suitability Test of the Air-Ground UHF Command Communication System, dated 9 June 52, stated that, although the AN/ARC-33 proved more reliable under test than the AN/ARC-27 and the AN/ARC-34 (XA-2), and proved easier to maintain than the AN/ARC-27, the AN/ARC-34 (XA-2) was considered the best of the three airborne equipments with respect to design, ease of operation, maintainability, size and weight, with a potential for greater reliability. It is pointed out that the AN/ARC-34 being procured at this time is similar to the (XA-2) development version tested by APGC except that it is greatly improved.

On 28 and 29 May 1953, representatives of Hq ARDC, WADC, Hq EADF and McGuire AFB met at McGuire AFB to discuss the feasibility of an operational engineering service test (nicknamed LITTLE EVA) with emphasis on engineering aspects. The 4709th Defense Wing of McGuire AFB was scheduled to be supplied with F-86D aircraft early in the summer. Being an operational wing, aircraft are continuously on the alert and fly missions. Installation of upwards of 20 sets would provide representative statistics on reliability of equipment, communications performance, ease of operation, ease of maintenance, and adequacy of unique, special-purpose test equipment designed specifically for AN/ARC-34.

In order that the wing could remain operational, it was mandatory that the aircraft be out of commission a minimum amount of time. Hence the AN/ARC-34 installation was designed on a temporary basis, disturbing as little equipment in the aircraft as possible. This installation is not typical of a standard installation and was merely an expedient to meet the imposed requirements. Standard UHF ground equipment would be used since Radio Set AN/ARC-34 is completely compatible with all such equipment presently used in conjunction with Radio Sets AN/ARC-27 and AN/ARC-33 now installed in USAF aircraft.

IMPLEMENTATION OF LITTLE EVA

SECTION I

The F-86D aircraft to be delivered to 4709th Defense Wing were equipped with Radio Sets AN/ARC-27. Inasmuch as Radio Set AN/ARC-34 was not a field proven piece of equipment, it was considered a wise precautionary measure to enable reinstallation of AN/ARC-27, in an emergency, in a minimum amount of time. The wiring required for Radio Set AN/ARC-27 was more than ample to supply the needs of Radio Set AN/ARC-34. Hence, it need not be disturbed if it could be adapted. This was accomplished by furnishing adapter plugs for connection between the AN/ARC-27 cable connectors and the AN/ARC-34. The AN/ARC-27 and its mounting would be removed, but the base plate would remain and be additionally drilled to accommodate a new base plate to which the AN/ARC-34 mounting was attached. An adapter was furnished for connection of the AN/ARC-34 control panel in the cockpit also. Adapters and hardware were furnished by WADC through prototype engineering and kit fabrication accomplished by Land Air, Inc., Cheyenne, Wyo. The original antenna and coaxial line were used.

The installation adopted required about 10 manhours to accomplish, but the AN/ARC-27 could be reinstalled in its original state in only 2 hours time.

It was planned to begin the Operational Engineering Service Test as soon as practicable in order to get in a significant amount of flying time. Inasmuch as large-scale production was scheduled to begin early in calendar year 1954, data were required as much prior to the end of calendar year 1953 as possible. The radio equipment contractor was already late in deliveries and availability of the sets was question mark. Then there was the matter of doing the actual job at McGuire AFB. Careful timing, coordination, and the utmost in cooperation of all parties concerned were essential to the successful initiation of the project in time to be of real value. Adapter kits were furnished 15 September together with the first AN/ARC-34's. The first set was completely installed by 21 September.

This is a noteworthy accomplishment for all concerned, considering that the first radio set was flying less than 4 months after the first planning meeting at McGuire AFB.

As of the writing of this report, 24 F-86D's are flying with AN/ARC-34's. At one time 27 were installed. The number was reduced for no reason connected with the AN/ARC-34. Additional sets are to be allocated from remaining quotas, and it is anticipated that all F-86D's at McGuire AFB will be equipped with AN/ARC-34.

OPERATIONAL DATA

SECTION II

Engineering bench tests on Radio Sets AN/ARC-34, AN/ARC-27 and AN/ARC-33 have indicated that differences in electrical performance were such that the equipments are essentially equal and that the probability of noticeable difference in service use was unlikely. However, under operational conditions, there is a difference in speech intelligibility in favor of AN/ARC-34 over AN/ARC-27. (See Appendix IX, Page 28, par. 2A; Page 33.) This is due primarily to the fact that the noise level of the AN/ARC-34 receiver is less than on the AN/ARC-27. The AN/ARC-27 transmitter has a wide audio band, presumably to meet the air-to-ground data link requirements of the Navy. In addition, the receiver bandwidth is greater. In the AN/ARC-34, the transmitter is designed for normal voice frequencies only. The selectivity of the AN/ARC-34 receiver has been sharpened. In UHF voice communications the AN/ARC-34 design features reduce background, internal, and atmospheric noises to be transmitted and received. If these factors are not sufficiently reduced, they affect intelligibility and serve to irritate the personnel psychologically. Under marginal reception conditions the message would be received on AN/ARC-34.

Radio Set AN/ARC-34 was designed for full operation up to altitudes of 50,000 feet without using a pressure-sealed case. In an unsealed equipment the three marginal factors are usually high-voltage corona in the transmitter output circuits, rapid dynamotor brush wear due to the very low water content of high altitude atmosphere, and inadequate equipment cooling. The rapid brush wear is normally encountered at altitudes above 30,000 feet and does not become appreciably worse at 50,000 feet. Most hours of flying were at altitudes over 30,000 feet. Two flights were made to 40,000 feet altitude. No troubles encountered have been attributable to high altitude operation.

Of major importance is maximum distance range. Three special flights were made to check maximum air-to-air and air-to-ground ranges. At 35,000 feet altitude, line-of-sight distance from the ground is 200 nautical miles, and air-to-air line-of-sight is double, or 400 nautical miles. The AN/ARC-34, air-to-air, provided satisfactory communications in excess of line-of-sight distance. The AN/ARC-34, airborne, provided satisfactory communications with AN/ARC-27 on the ground in excess of line-of-sight distances. (See Appendix VI, Page 20). Due to propagation conditions, the frequency at which line-of-sight communications could be obtained air-to-air was not always the same as the frequency which would provide line-of-sight communications air-to-ground. The radio set itself had nothing to do with any propagation effects, and the scope of project LITTLE EVA did not permit

the exhaustive investigation required to obtain such significant data. Sufficient flights were made, however, to determine that good reception was not contingent on transmission anomalies. As pointed out earlier, at maximum ranges, and under marginal conditions *AN/ARC-34 should provide good communications intelligibility* by virtue of the low receiver and transmitter noise levels.

While not at all attributable to Radio Set AN/ARC-34, variations in antenna patterns of the F-86D were checked by means of flying circles in the air and checking air-to-air and air-to-ground signal variations, and by making many simulated GCA approaches. No aircraft UHF antenna pattern is omnidirectional. On the F-86D, the tailcap antenna pattern has a distinct null forward and downward, which might show up in GCA operations. However, no communications difficulties attributable to the antenna pattern were found when the aircraft assumed normal approach attitudes. (By the simple expedient of remoting the GCA transmitter and receiver and moving them laterally from the landing strip, any such effects could be avoided if such an expedient were found to be necessary.)

Although Radio Set AN/ARC-34 was not designed as a ground or mobile equipment, 393 hours of operating time were obtained as of 22 Feb on this set in a mobile unit used for instructions to aircraft pilots in scramble prior to takeoff.

When setting up frequencies on the AN/ARC-27, two personnel are employed, one in the cockpit at the control panel, and one at the location of the intermediate set-up box. One person can set up the frequencies on AN/ARC-34 in less time than the two men required on the AN/ARC-27.

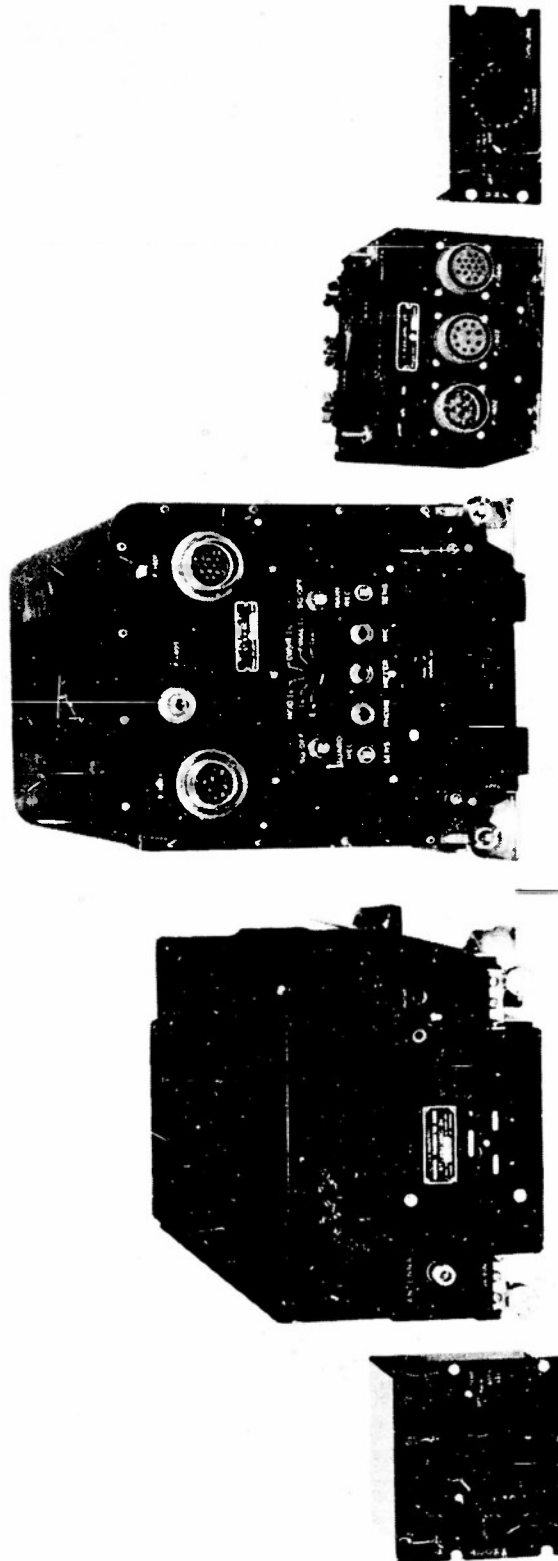
INSTALLATION AND MAINTENANCE DATA

SECTION III

An exercise such as LITTLE EVA, under actual field operating conditions, is invaluable experience to every one who is not normally closely associated with detailed maintenance activities and difficulties. It requires on-the-spot knowledge to realize the differences which can exist between two equipments which, to all intents and purposes, perform the same function. *The AN/ARC-34 is easier to install and maintain than AN/ARC-27.* (See Appendix VIII and Appendix IX, page 29 par. 3C,D,E,F,4; pages 30, 34).

When AN/ARC-34 was installed in place of AN/ARC-27 in the F-86D aircraft, the smaller size of the AN/ARC-34 (Appendix I, Page 15) left enough unoccupied space to permit the additional installation of such equipments as, for example, Radio Set AN/ARC-44, which could not be installed when the AN/ARC-27 was used. This will be true in all high performance, space-premium aircraft. The available space will be even greater when the AN/ARC-34 is properly installed and not just adapted, as pointed out in SECTION I. The saving in usable installation space provided by the receiver-transmitter unit alone will be one cu. ft.

Weight reduction is afforded by AN/ARC-34. (See Appendix I, Page 15). Considering only the receiver-transmitter units, the difference is 23 lbs. in favor of the AN/ARC-34. It requires two men to install or remove the AN/ARC-27 transmitter-



AN/ARC-27

AN/ARC-34

Fig. 2. RADIO SET AN/ARC-34 AND RADIO SET AN/ARC-27

receiver unit, whereas only one man can perform the same operations with the AN/ARC-34 unit. (See Appendix IX, Page 29, par. 3E). This represents a 50% reduction in manpower requirements for these operations. Also worthy consideration is the fact that additional equipment may be carried in the airplane in which the AN/ARC-34 is installed, or long distance range extension by virtue of less overall airplane weight may be realized. There is no known rule-of-thumb for the latter factor (See Fig. 2, Page 5.)

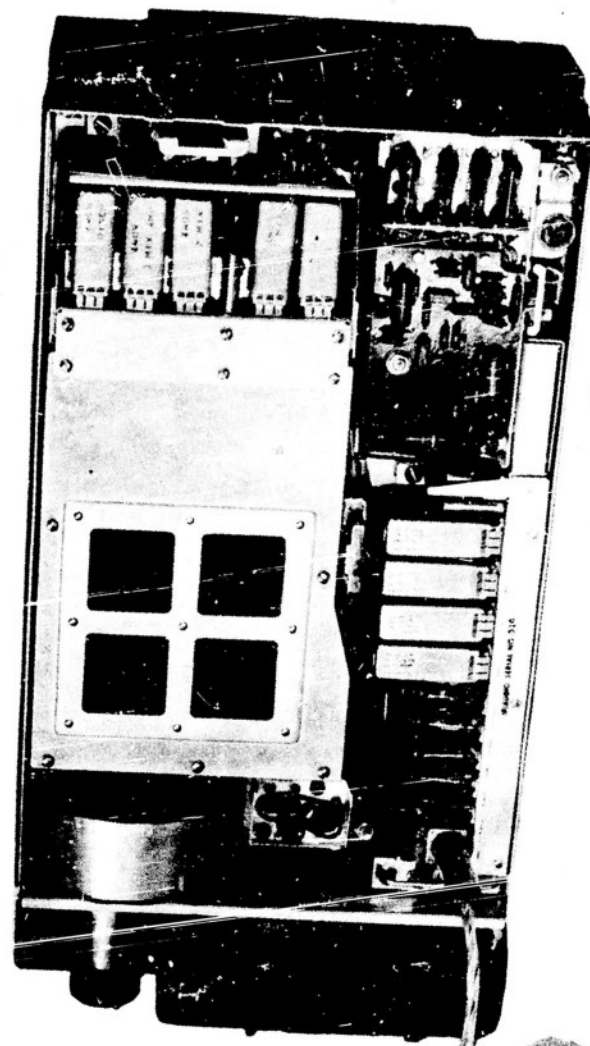
The worth of the ARDC concept of complete unitized construction and a simple "go-no-go" preliminary test meter for isolation of equipment faults, in radio communication equipments (first employed in Radio Set AN/ARC-33 and brought to culmination in the ARC-34) has been demonstrated through LITTLE EVA. (See Fig. 3, Page 7.) Although the AN/ARC-34 is a newly-designed equipment and unfamiliar to the field, three Technical Representatives (two under the jurisdiction of WADC and one supplied by the Equipment Contractor,) together with the normally assigned maintenance personnel, have maintained the Radio Sets AN/ARC-34 (organization and field level) in addition to the required training activities.

Most outstanding have been the findings through the unorthodox maintenance procedures which were necessary in an exercise like LITTLE EVA wherein no arrangements are possible for field and depot facilities except the manufacturer's plant. There were many minor breakdowns, (mostly of quality control nature) which makes it all the more significant that the USAF maintenance personnel, of only organizational level, with the help of three technical representatives, have completely maintained all Radio Sets AN/ARC-34 at McGuire AFB. (See Appendix IX, Page 27.)

As an example of ease of maintenance of Radio Set AN/ARC-34, a set was accidentally dropped seven feet to the concrete apron, and was put in original operable condition the same day, at McGuire AFB.

Unique to AN/ARC-34 is the feature of being able to isolate a faulty sub-assembly quickly and replace it immediately without tearing down the whole equipment. Each subassembly of AN/ARC-34 is provided with a socket accessible without removal of any subassemblies. The use of a simple, plug-in, "go-no-go" multimeter permits isolation of the fault to a unit, by personnel having the very lowest level of maintenance training. The subassembly is simply replaced by a like spare and the equipment is again operative. No adjustments whatsoever are required, and even tubes need not be changed in such an operation. A screwdriver is the only tool required for removal or installation of any AN/ARC-34 subassembly. There are no soldered connections involved, no positioning of splines, shafts or gears. There is nothing which would be accidentally misadjusted in the replacement operation. (See Fig. 3, Page 7.) Inasmuch as complete subassemblies are obtainable as spares, it is possible to eliminate even testing and changing vacuum tubes at organizational level.

The design of Radio Set AN/ARC-34 for ease of maintenance includes the feature of sealed minor units which may, in the interests of saving manhours of maintenance time, be wholly discarded and replaced with like units. Representative of such are i-f stages which include even the vacuum tube within the hermetically-sealed envelope. It has been found through research on the subject, that often it may be



RECEIVER-TRANSMITTER, RADIO RT-263/ARC-34.

VOLTAGE POINT TEST SET
RCA TYPE MI-25137

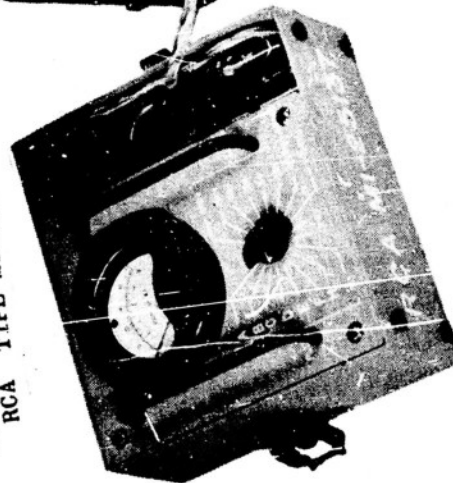


Fig. 3 USE OF "GO-NO GO" METER

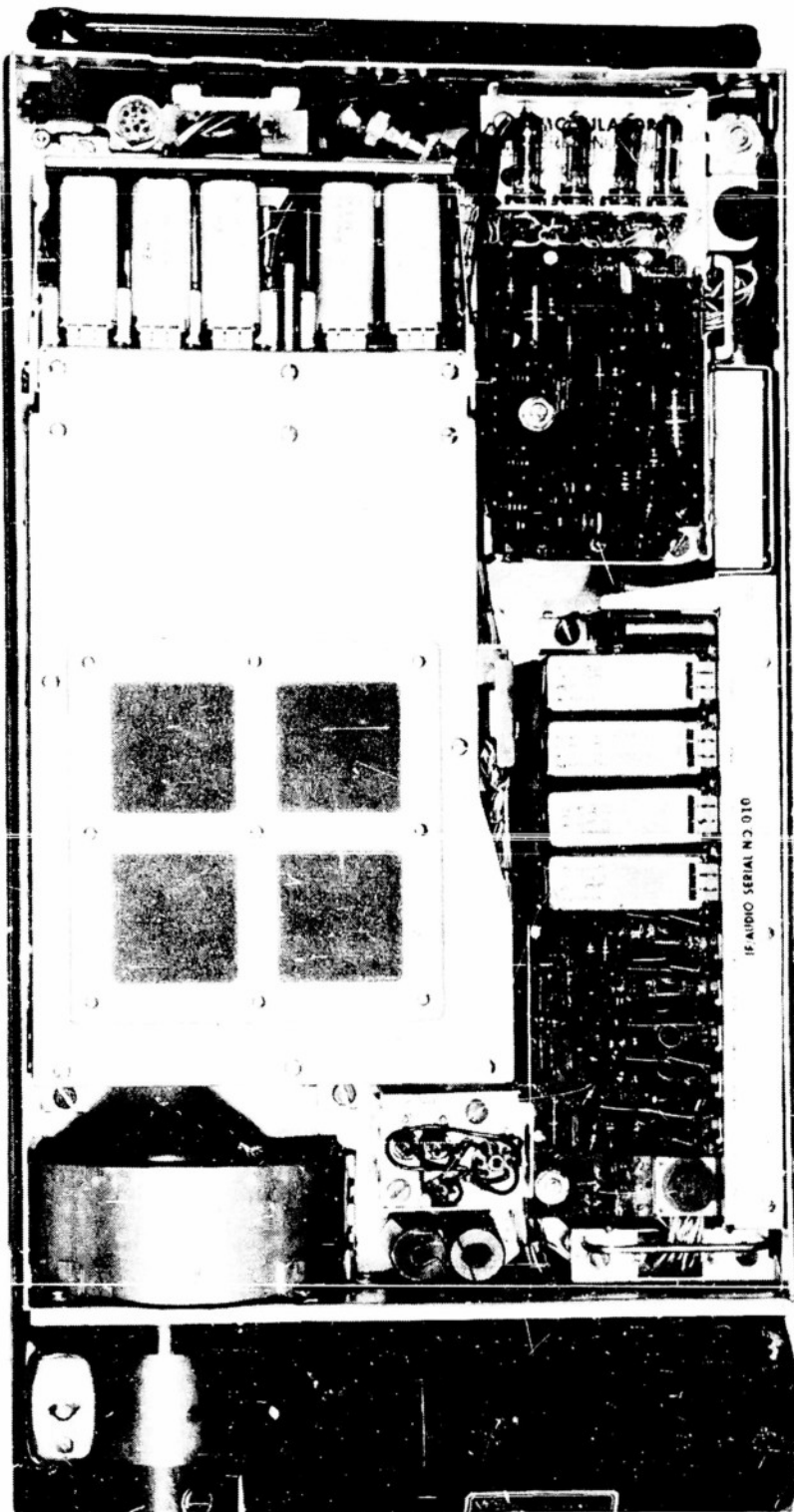


Fig. 4 TOP VIEW, RT-263/ARC-34

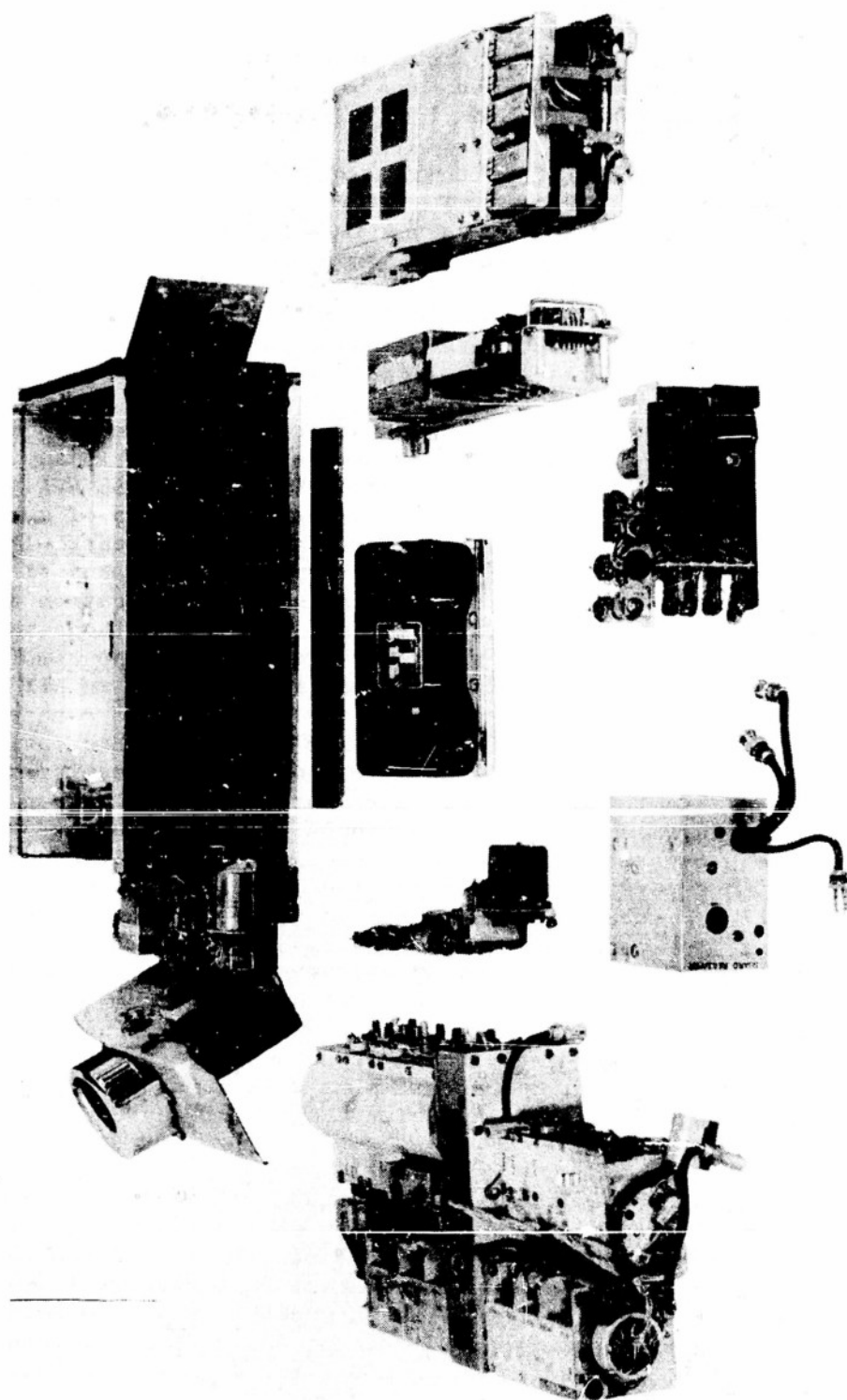


Fig. 5 AN/ARC-34, DISASSEMBLED

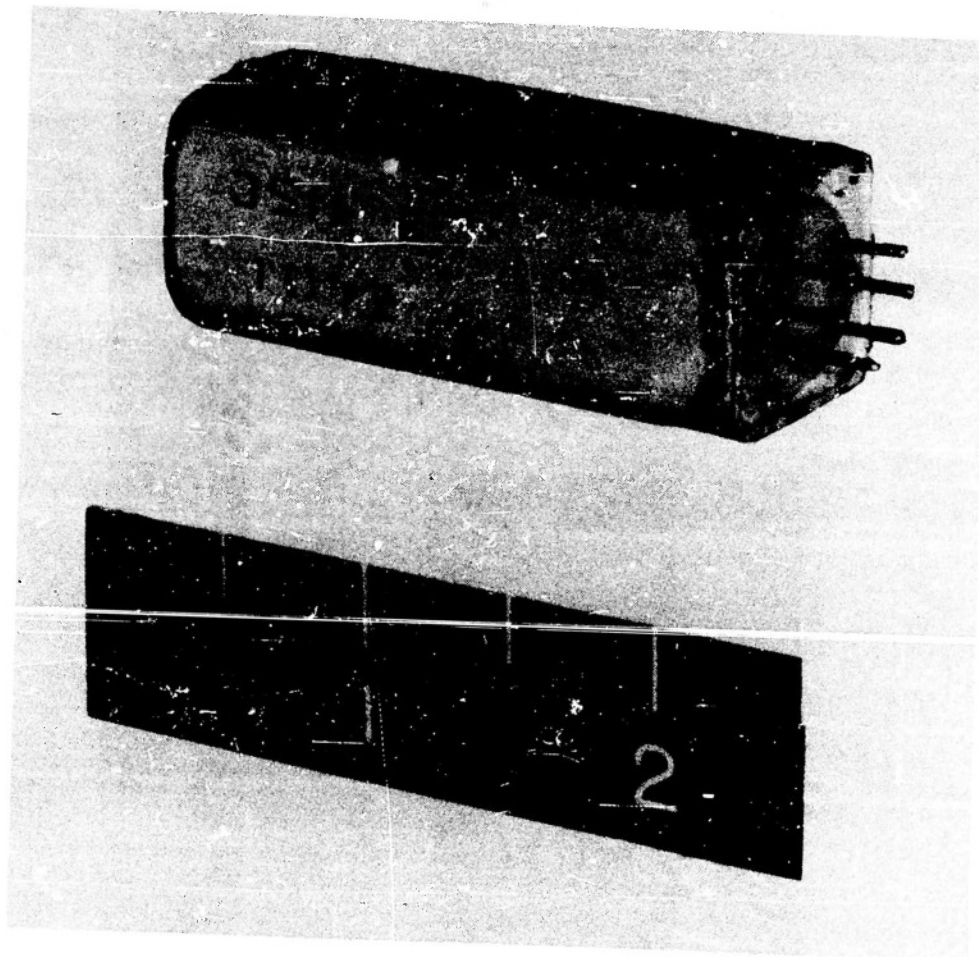


Fig. 6 PLUG-IN OSCILLATOR STAGE

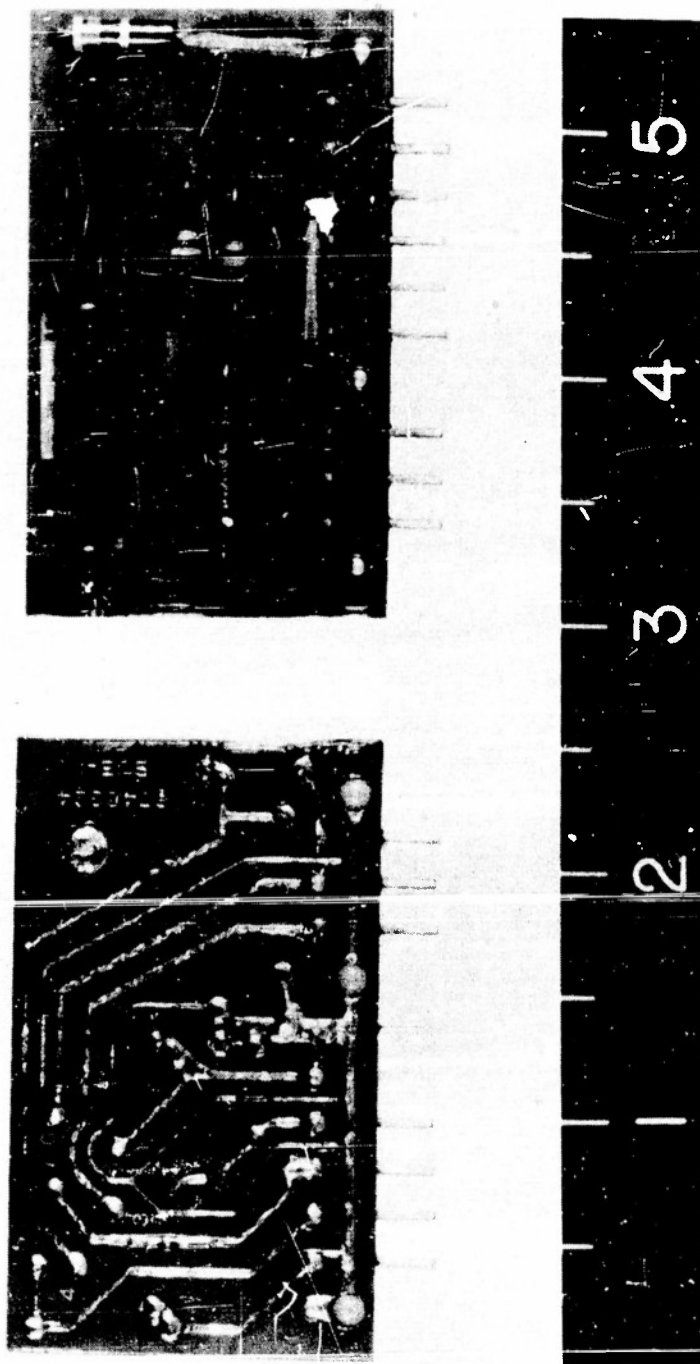


Fig. 7 PLUG-IN OSCILLATOR ASSEMBLY

99 faults attributable to AN/ARC-34, 13 of them occurred on two of these original equipments. Considering all troubles, except for the thyatron failures which numbered 12 and ratchet motor which numbered 19, there was no pattern to the failures. They consisted of isolated cases such as individual component failures, misadjustments, cold solder joints, broken leads, and the like, mostly quality control items which should not exist at all. The contractor states that the quality of the equipment at the time of writing this report, is greatly improved. In large-scale production, proper exercise of quality control reduces such failures to an insignificant number. The contractor is initiating all possible corrective measures. Operational hours per set and failures are listed in Appendices III and V respectively. It is pointed out that no distinction was made as to whether the failure occurred during operational use in the air or on the bench when AN/ARC-34's were being checked prior to first installation. Hence all failures are recorded. Included are those not attributable to Radio Set AN/ARC-34 itself but to the UHF communication system in the aircraft.

CONCLUSIONS

SECTION IV

In summary of the foregoing sections of this report, the following conclusions are drawn:

- a. Under ordinary operating conditions, Radio Set AN/ARC-34 provides satisfactory voice communications to at least line-of-sight distances air-to-air and air-to-ground. By virtue of the design restriction of the audio band to voice frequency range, good r-f selectivity, and low receiver noise level, under marginal communications conditions, signals will be intelligible on AN/ARC-34.
- b. Radio Set AN/ARC-34 is satisfactory for operation up to altitudes of 50,000 feet without pressurization.
- c. Radio Set AN/ARC-34 will be an adequately reliable equipment for service use.
- d. The reduced size of AN/ARC-34 makes it possible to either install it in a much smaller space than that needed for Radio Sets AN/ARC-27 or to leave room for the installation of additional equipment not possible to install when AN/ARC-27 is used.
- e. The reduced weight of AN/ARC-34 allows easy installation and removal by one person whereas AN/ARC-27 normally requires two personnel for the same operation. In addition, the saving in weight can be reflected in the ability of the airplane to carry additional equipment not possible if AN/ARC-27 is installed, or in extended distance range by virtue of reduced airplane weight.
- f. The simplified preset frequency system permits one person to set up all channels in a minimum of time.

g. The maintenance features designed into the AN/ARC-34 result in requirements for fewer maintenance personnel, less training of these personnel, less skill, and result in faster maintenance at organizational and field echelons, than for Radio Set AN/ARC-27. At Organizational level, it is estimated that at least 75% of defective Radio Sets AN/ARC-34 can be immediately restored to service. This is 50% more than for AN/ARC-27. This also reduces the load on higher maintenance echelons. It is estimated that overall maintenance cost for AN/ARC-34 would be 40% less than for AN/ARC-27 at Field level. Savings at Depot level cannot be estimated at this time except that, as at all levels, decreased size and weight, requirements for fewer complete sets as spares, etc., will reduce shippings, handling, and packing by an estimated 30%. It may be well to review the redistribution of tasks within the various maintenance echelons as a result of the discoveries in operation LITTLE EVA.

h. The first cost of an equipment is no criterion whatsoever as to the true overall cost to the Government over the normal period of useful life. Maintenance costs should be the prime consideration. In support of these statements, the following is quoted from USAF Project RAND Report RM-1002, Subject: "The Cost of Unreliability of Air Force Airborne Electronic Equipment as Represented by the Cost of Maintenance.":

"This analysis has established that it is costing the Air Force about two dollars per year to maintain every dollar's worth of airborne electronic equipment. Therefore, during the life of the equipment somewhere between eight and ten times its original cost is being spent in maintenance. This figure bears out an estimate made by the Navy that as much as ten times the initial cost of electronic equipment is spent in maintenance throughout its life."

If the amount of maintenance effort could be cut in half by improving the reliability and maintainability of the equipment, substantial savings could be made. Even if the first cost of the equipment were doubled, no increase in net cost per equipment for the first year would result, and based on present standards, three times the original cost of the equipment would be saved."

i. As a complete piece of equipment, the design of AN/ARC-34 is satisfactory. LITTLE EVA has indicated the necessity for relatively few design changes even from the ease of manufacture aspects. Thus there should be a minimum delay in initiation of future production deliveries. AN/ARC-34 is a definite improvement in the state of the art, and provides advantages over Radio Set AN/ARC-27 in size, weight and ease of maintenance. These advantages should be utilized as rapidly and as extensively as practicable.

APPENDIX I
EQUIPMENT SIZES AND WEIGHTS

RADIO SET AN/ARC-34

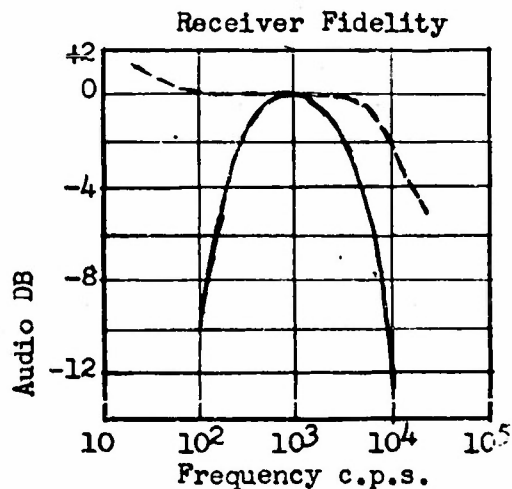
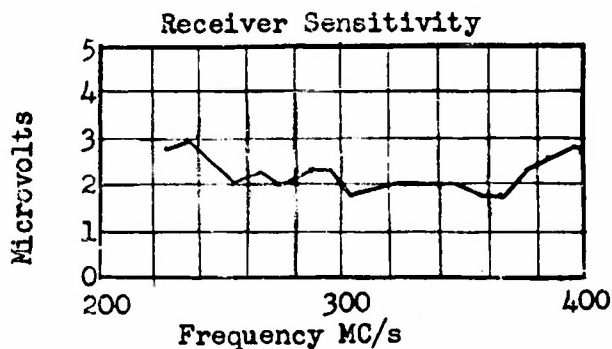
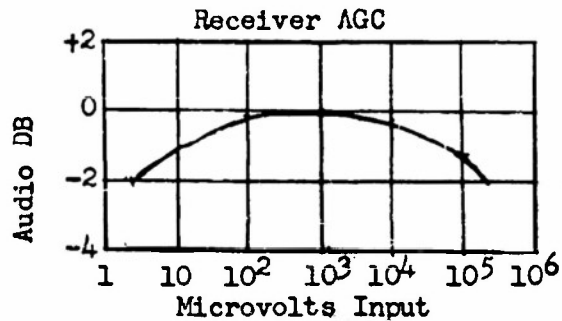
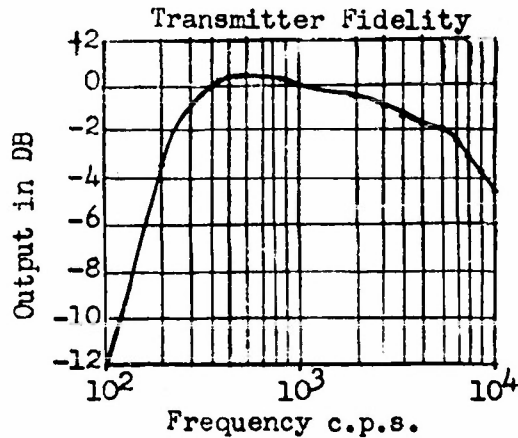
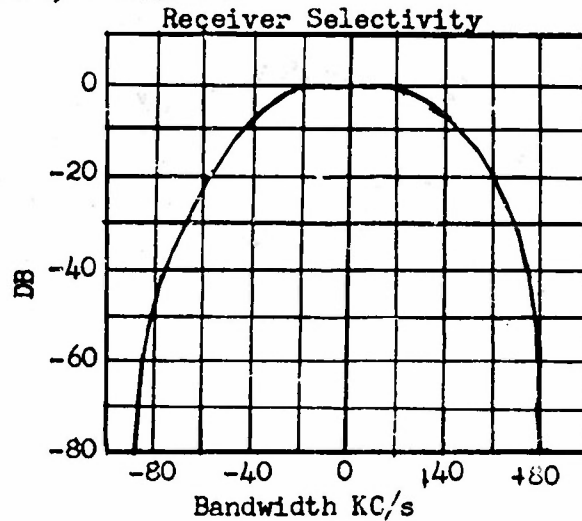
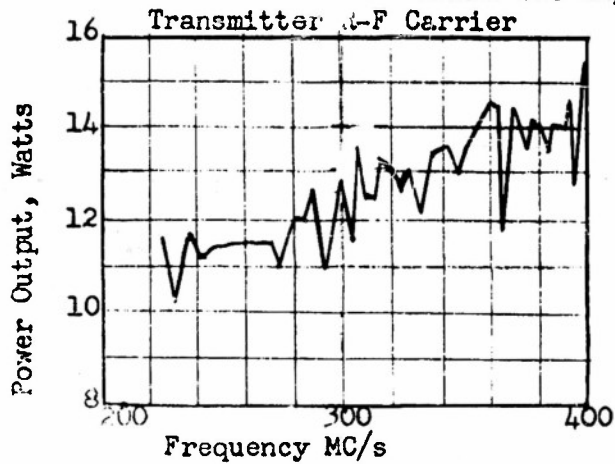
Item	Dimensions in Inches			Weight, Pounds
	Width	Height	Depth	
Receiver-Transmitter, Radio, RT-263/ARC-34	10-1/8	7-9/16	21-11/16	47.5
Mounting MT-1099/U	11-15/16	2-1/8	22-5/32	3.5
Control, Radio Set C-1057/ARC-34	5-3/4	3-7/8	6-1/32	<u>2.5</u>
			Total	53.5

RADIO SET AN/ARC-27

Receiver-Transmitter RT-178/ARC-27	11-1/4	12-3/8	27-7/8	70.5
Mounting MT-822/ARC-27	11-1/8	2-3/8	19-3/4	4.0
Set Up Control C-626/ARC-27	6-3/8	9-5/16	5-1/2	9.0
Mounting MT-821/ARC-27	6-37/64	6-11/16	3/8	.6
Control Panel C-628/ARC-27	5-3/4	2-5/8	3-5/8	<u>1.0</u>
			Total	85.1

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APPENDIX II
Typical Performance Curves
Radio Set AN/ARC-34, Serial A-1



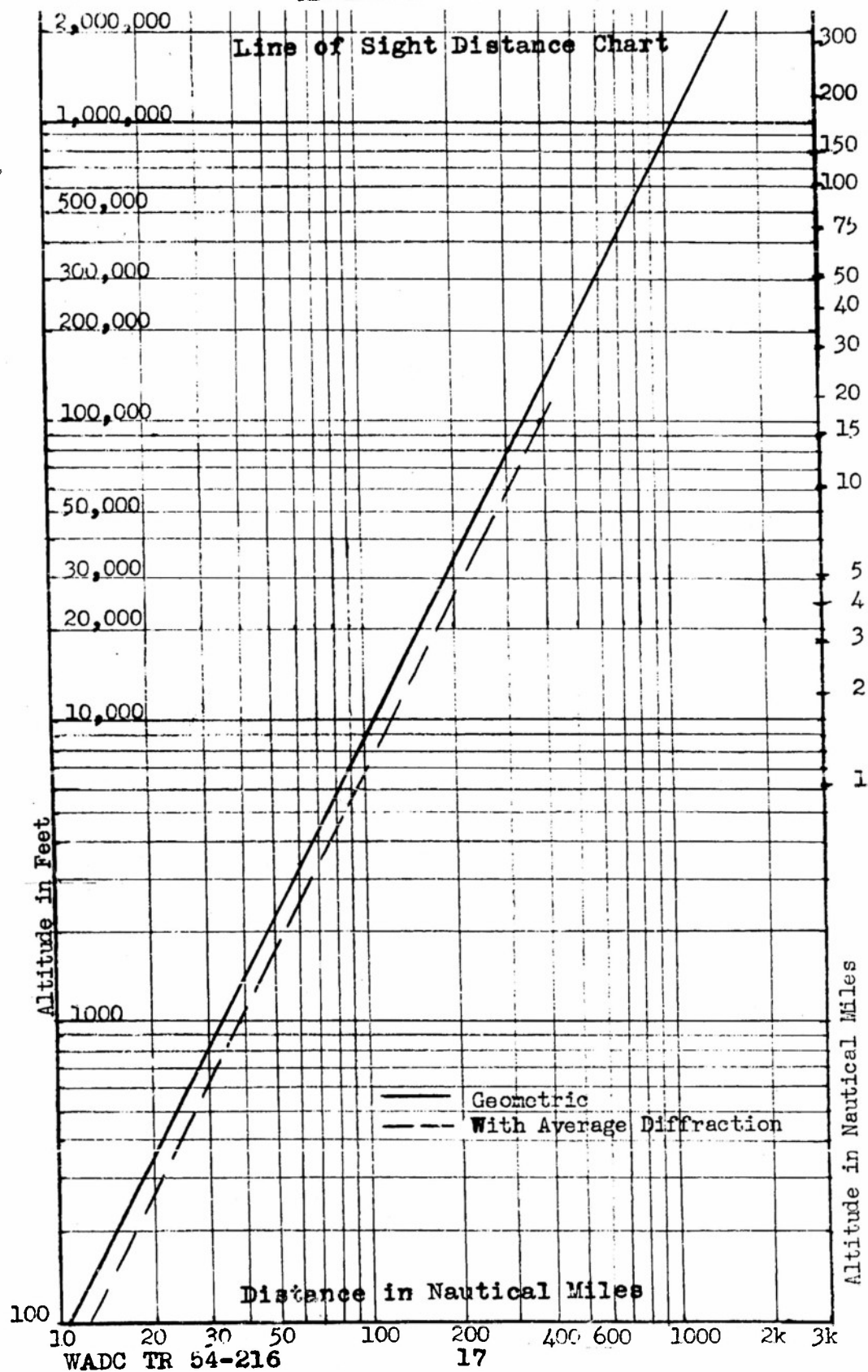
ALTITUDE: 50,000 feet plus. At some altitude above 50,000 feet, internal corona will occur which causes no permanent damage and permits transmission under a reduced power condition.

BRUSH LIFE, HIGH ALTITUDE: at least 1000 hours. SALT SPRAY: per QQ-M-151

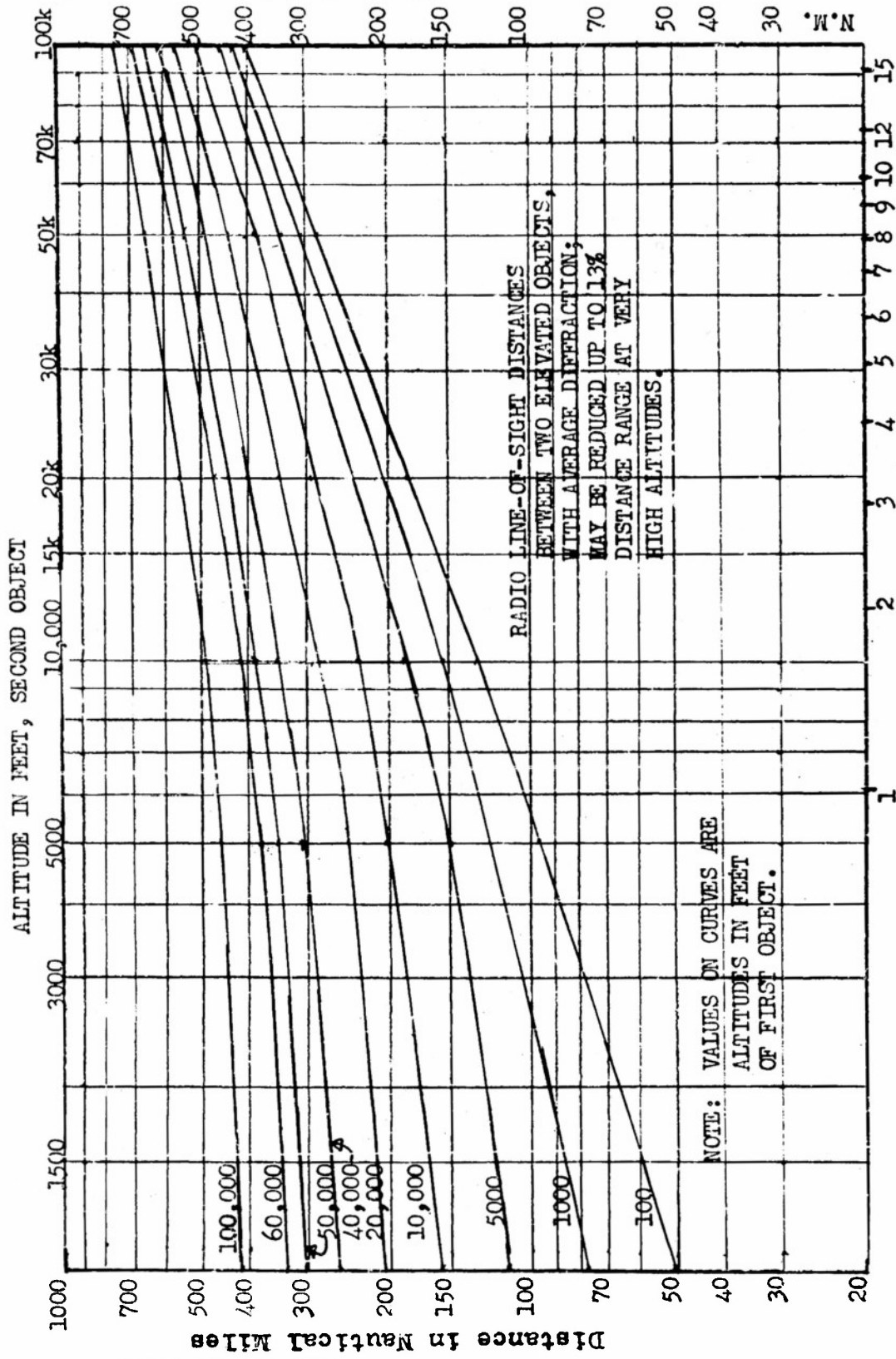
LIFE TEST: 200 hours without maintenance. HUMIDITY: 30 days

VIBRATION: 10-55 cps, 0.06" amplitude. TEMPERATURE: -55°C to +71°C operating.

APPENDIX III



APPENDIX IV



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GHS
2/8/54

APPENDIX V

AN/ARC-34 UTILIZATION

Operating Hours in Flying Airplanes:

<u>Set No.</u>	<u>Hours</u>	<u>Set No.</u>	<u>Hours</u>	<u>Set No.</u>	<u>Hours</u>
A-4	28:00	A-17	13:25	A-31	0
A-5	23:05	A-18	0	A-32	10:30
A-6	23:45	A-19	:45	A-33	9:55
A-7	2:45	A-20	10:15	A-34	6:40
A-8	12:45	A-21	17:40	A-35	0
A-9	1:00	A-24	12:55	A-36	0
A-10	13:10	A-25	0	A-37	5:35
A-11	0	A-26	21:15	A-38	0
A-12	8:30	A-27	1:45	A-39	0
A-14	16:20	A-28	1:25	A-40	:45
A-15	14:10	A-29	2:50	A-41	:50
A-16	15:55	A-30	2:20	A-42	0

Total hours 278:25 as of 22 Nov 53

Operating Hours in Mobile Ground Station:

<u>Set No.</u>	<u>Hours</u>
A-18	91:00
A-19	22:00
A-33	6:00

Total Hours 119 as of 22 Nov 53

Operating hours, grand total 397:25, exclusive of operation on bench.

Nineteen frequencies were used, from approximately 228 mc/s to approximately 389 mc/s. Eleven frequencies were below 300 mc/s and eight were above.

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APPENDIX VI

AN/ARC-34 FLIGHT STATISTICS

There were approximately 250 flights made. Most of these routine flights were at altitudes of 30,000 feet with some as high as 35,000 feet. In routine missions, no attempt was made to reach maximum communications range. Rather, Radio Sets AN/ARC-34 were used as they would be in normal mission profiles. Distance ranges per flight varied between 100 and 150 nautical miles. (At 30,000 ft. altitude, line-of-sight distance is 190 n.m.)

There were three special flights made specifically to check UHF communications performance:

1. High Altitude. Two aircraft went to an altitude of 40,000 feet and remained there approximately ten minutes each, transmitting at least 25% of the time. There were no equipment or communications failures.
2. Maximum Distance Range.

Two aircraft flew courses at 180° from each other in order to obtain greatest separation in the least elapsed time. Both flew at an altitude of 35,000 feet. Maximum separation was 405 miles at which time the aircraft still had intelligible communications, but were required to return due to fuel limitations. At 35,000 feet altitude, line-of-sight distance, air-to-air is 400 n.m. In order to check antenna patterns each aircraft made a 360° turn at maximum range. Since the aircraft did not reach maximum range at the same time, one circle was made at a separation of 390 n.m. and the other at 370 n.m. There was no loss in communications which indicated that antenna pattern nulls were tolerable in this flight.

Ground-to-air and air-to-ground communications were maintained with the aircraft from two ground stations, both using AN/GRC-27, one at McGuire AFB and one at a GCI site nearer the coast. Line-of-sight distance was 200 n.m. From McGuire AFB, intelligible communications were obtained when one aircraft was at 235 n.m. The other aircraft did not exceed 170 n.m. in its flight pattern and so did not approach limiting communications conditions. Even at 235 n.m., the limit had not been reached. Although the signals were weak, they were clear. During this flight, the aircraft were 200 and 205 n.m. respectively from the GCI site. Although the signals, at these ranges were weak, they were clear, so the limit was not reached.

3. Another flight similar to 2 above was attempted. Maximum air-to-air range obtained was 265 n.m. and distances from the GCI site were 135 and 130 n.m. respectively. At these distances the flight aborted, and line-of-sight distances were not approached. Therefore no significant data were obtained from this flight.

APPENDIX VII

AN/ARC-34 MAINTENANCE STATISTICS

Installation Faults not Attributable to AN/ARC-34.....	3
Total AN/ARC-34 faults.....	51*
Total number of Adjustments Required.....	12
Thyratron Failures (Prior to set design change).....	10
Thyratron Failures (Subsequent to set design change).....	0
Vacuum tube Failures (exclusive of Thyratron).....	15

*Eleven faults occurred in only two, early-built equipments.

Analysis of failures

Improper connections: shorts, cold solder joints, and broken wires, all quality control items, no definite pattern..... 14

Component Failures:

Ratchet Motor; contacts get dirty; the contractor is investigating the design to eliminate this fault..... 11

Relays.....	3
Tube Sockets.....	2
Capacitors.....	6
Resistors.....	5
Sealed I-F Stages.....	2
Connecting Plug.....	1
Crystal Unit.....	1

Exclusive of the ratchet motor, there was no more than one fault per individual type; no pattern.

Of the 15 vacuum tube failures, only two tube types failed more than once. There were three failures of A2413A. These were tubes of early manufacture. The design has since been corrected. There were two failures of 5876. This fact is not considered significant.

There were six miscellaneous mechanical failures, all quality control items with no pattern.

APPENDIX **VIII**

STATEMENTS FROM HQ AMC:

Gentile AFB

Directorate of Maintenance Engineering

C O P Y

Basic ltr fr Gentile AF Depot dtd 23 Nov 53, subj: (Uncl) "Maintenance Support Evaluation ARC AN/ARC-34 UHF Sets".

1st Ind

Headquarters Air Materiel Command, Wright-Patterson AFB, Ohio, 24 Nov 53

TO: Commander, Wright Air Development Center, ATTN: WCLN, Wright-Patterson Air Force Base, Ohio

1. Basic communication is the result of a comprehensive on-the-spot maintenance evaluation of the AN/ARC-34 UHF Equipment. Gentile AF Depot's findings that the AN/ARC-34 is far superior, from a maintenance viewpoint, to other airborne UHF equipments presently in use by the Air Force confirms the pre-production evaluation made by this Command. However, the conclusions reached by Gentile become even more significant when it is considered that the study was accomplished at the using organizations level, on AN/ARC-34's installed in operational aircraft, and was made by highly qualified technical personnel thoroughly familiar with all levels of Maintenance problems presently being encountered on airborne UHF equipments currently in Air Force use (i.e. AN/ARC-27 and AN/ARC-33). It is therefore important to note that these personnel were in a position to make a bonafide comparison of practical maintenance requirements and capabilities at all levels.

2. It is generally accepted that any equipment, which because of its design and construction, allows ready diagnosis of failures of assemblies, sub-assemblies and plug-in units within basic components, by organizational personnel, without requiring extensive electrical or mechanical realignment, possesses an important maintenance advantage which cannot readily be measured in dollars. Also, when these same assemblies and sub-assemblies can normally be repaired at field level additional maintenance advantage exists.

3. Furthermore, maintenance derives considerable benefit from the fact that only assemblies, sub-assemblies, and plug-in units will normally be returned to the Depot for overhaul. In turn, this condition will reduce Depot man-hour requirements, as well as packaging, transportation, storage and issue costs.

4. Any equipment which can easily be maintained during the period of time it is in Air Force use might well prove more economical to the Air Force by the end of its projected life span than a considerably cheaper, similar equipment which presents complex maintenance problems.

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C O P Y

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"Maintenance Support Evaluation ARC AN/ARC-34 UHF Sets"

5. In view of the superior maintenance capabilities of the AN/ARC-34, it is recommended that this equipment be made the "Standard" UHF airborne equipment for the Air Force. Future developments of electronic equipments should also provide adequate maintenance capabilities, similar to those incorporated in the AN/ARC-34.

FOR THE COMMANDER:

WALTER W. WISE, JR.
Brigadier General, USAF
Deputy Director
Maintenance Engineering

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24

C O P Y

C O P Y

HEADQUARTERS
GENTILE AIR FORCE DEPOT
WILMINGTON PIKE
DAYTON 10, OHIO

Nov 23, 1953

MDG

SUBJECT: Maintenance Support Evaluation ARC AN/ARC-34 UHF Sets

TO: Commander
Air Materiel Command
ATTN: MCM
Wright-Patterson Air Force Base, Ohio

1. The Maintenance concept for support of Electronic Equipment has been previously outlined by Headquarters, Air Materiel Command. The following is a comparison between the AN/ARC-34 and other UHF Sets utilizing this concept as a guideline:

a. Statements outlined in the following paragraphs are the result of this comparison:

- (1) Equivalent repair of the ARC-34 can be accomplished at a lower echelon of Maintenance than compared UHF Sets. This makes it possible to have a larger percentage of sets maintained in an operational status utilizing Field and Organizational repair. The reason for this lower repair echelon is due to the utilization of sub-assemblies, printed wiring and plug-in assemblies. All subassemblies can be replaced without the requirement for realignment except for minor realignment of the RF Head when that subassembly has been repaired.
- (2) Organizational and Field maintenance activities can maintain the ARC-34 with a minimum of technical skill, knowledge and spare parts. Organizational maintenance can replace all subassemblies without additional alignment required. This condition does not exist with other UHF Sets. Realignment is necessary when subassemblies are replaced. In addition not all subassemblies can be replaced at the Organizational level. After the

HQ GENTILE AF DEPOT MDG SUBJECT: Maintenance Support Evaluation ARC AN/
ARC-34 UHF Sets

removal of the subassemblies by Organization Activities, the Base or Field shops will be capable of performing repairs on the subassemblies without returning subassemblies for Depot maintenance. This is not the condition existing with present UHF Sets such as the ARC-27, in which several assemblies must be returned to the Depot for maintenance. An example that can be cited of the case of maintenance is a complete replacement of subassemblies on UHF Sets in present use required from two (2) to four (4) hours, whereas the ARC-34 required approximately thirty minutes for reassembly.

- (3) Depot maintenance on complete sets will be greatly reduced as shipment of printed circuits, subassemblies and plug-in assemblies will be the greater percentage of Depot repair requirements. This constitutes a great savings in transportation, packaging and storage as the necessity of complete units to be maintained throughout the Supply pipeline will be minimized. Also the requirement for extensive stockage of bits and pieces is reduced. This reduction in Maintenance of ARC-34 will be a result of Organizational and Field maintenance activities having capabilities of effectively performing a higher degree of repair with a lower skill requirement. It is apparent from present depot operation that with other UHF Sets, this procedure of repair could not be effectively carried out. From available information to date, the bit and piece requirement of other UHF Sets is very high in comparison to requirement for the ARC-34.

2. Considering transportation, packaging, storage and issue, training requirements, available skill etc., it is the opinion of this Activity that Maintenance and Supply support at Organizational, Field and Depot level of the AN/ARC-34 will be considerably easier to accomplish than UHF Sets presently in use.

LESLIE G. MULZER
Colonel, USAF
Commander

WADC TR 54-216

C O P Y

APPENDIX IX

STATEMENTS FROM EADF OF ADC

WADC TR 54-216

2ND FIGHTER INTERCEPTOR SQUADRON
568TH AIR DEFENSE GROUP
McGuire Air Force Base
Trenton, New Jersey

23 November 1953

SUBJECT: Project "Little Eva," operational testing of AN/ARC-34

TO: Commanding Officer
Communication and Navigation Laboratory
Wright Air Development Center
Wright-Patterson Air Force Base, Ohio

1. The AN/ARC-34 has been undergoing tests at this organization since 22 August 1953. Since the time we installed the first set the main difficulties and good points encountered are listed below.

A. The pilots have expressed numerous complaints concerning the control box, C-1057, of the AN/ARC-34, some of which are listed below.

a. Channel switching mushy, should be more positive locking or better means of switching channels. In changing channels it is very easy to skip over the desired channel. For instance, in switching from channel seven (7) to channel (8), very often channel eight (8) is skipped and the set tunes up to channel nine (9).

b. The two channels on either side of the channel selected should be blanked out better. At the present time green shielding is over the two channels on either side of the channel selected but due to aircraft lighting and the fact that the control box is mounted to the side of the pilot it is very easy to inadvertantly select the wrong channel unless the pilot bends down and over to make close check on control box. This being a very dangerous practice especially when in formation or under instrument conditions.

c. A stop should be installed between channels one (1) and twenty (20) to prevent continuous channel selecting as is now possible.

d. The ability to switch to manual tuning is considered an exceptional asset by the pilots. It has been used on several occasions successfully.

2. The only remarks passed by flying personnel on the RT-263, AN/ARC-34 were favorable and are listed below.

A. Reception very noise free. Exceptionally low level of background noise. It is considerable better than any other UHF set utilized by pilots. Reception good under adverse conditions.

3. The following opinions were expressed by the maintenance personnel actually involved in the installation, trouble shooting and repairing of the AN/ARC-34.

A. Antenna recessed. Extremely hard to connect.

B. Winchester plug that is used to apply control and power to the set is too small for number of cables entering, and it is extremely difficult to position when installing set into aircraft. If set becomes only slightly loose in its mount due to vibration, the set will not operate due to the Winchester plug being used.

C. The trouble shooting is exceptionally easy to perform, well defined and can be considered an excellent asset to the maintenance personnel. It is in our opinion the most well constructed, best designed, compact and extremely efficient unit ever worked on by personnel of this organization.

D. The Communications section believes that with the AN/ARC-34 installed in the aircraft assigned, the efficiency, incommision rate and trouble free conditions will greatly increase over other UHF equipment formerly worked with.

E. The weight difference between the AN/ARC-34 and the AN/ARC-27 is an asset to the maintenance personnel. With the AN/ARC-27 it was necessary to have two persons to remove the set due to the weight involved, but with the AN/ARC-34 one person can remove the set for repair.

F. The removable subassemblies are also a great boon to repairing due to the considerable ease with which this can be accomplished and the equipment supplied makes trouble shooting easy and efficient.

4. It is the overall opinion of both the flying and maintenance personnel that the AN/ARC-34 far surpasses in practically all aspects any other Airborne UHF set now in general use in the Air Force.

/s/James O. Tyler
JAMES O. TYLER
Lt. Col. USAF
Commander

C O P Y

OFFICE OF THE DEPUTY FOR MATERIEL
4709TH DEFENSE WING
McGuire Air Force Base
Trenton, N. J.

SUBJECT: Project "Little Eva"

TO: Communications and Navigation Laboratory
Attn: Lt. Colonel V. E. Redding

1. As project officer for McGuire Air Force Base on the service testing of the AN/ARC-34 Radio Set, I have had the opportunity to observe both the operations and maintenance problems under field conditions.

2. I have noted that the general characteristics, operational suitability and relative maintenance simplicity, are distinctive features most desirable for ideal field operation.

3. Attached hereto are several statements obtained from both operational and maintenance personnel affiliated with the ARC-34 Project.

/s/ F. E. Hutchins
F. E. HUTCHINS
Major, USAF
Communications & Electronics Officer

C O P Y

OPERATIONS OFFICE
5TH FIGHTER-INTERCEPTOR SQUADRON
568TH AIR DEFENSE GROUP
McGuire Air Force Base
Trenton, New Jersey

5 November 1953

SUBJECT: ARC - 34 Project

TO: Project Officer
"Little Eva"

I, Captain D. H. Trexler, USAF, having just recently commenced flying aircraft equipped with UHF radios, have not had too much experience with this new type of communication. My experience with the ARC-27 has been very satisfactory.

Recently Captain Nolan and myself made a flight in two aircraft equipped with the ARC-34. Our intership communication was satisfactory at all altitudes to 40,000 feet. I did experience difficulty in reception, both from the other aircraft with which I was flying formation, and from the GCA unit on Channel 17. Captain Nolan had no such difficulty. So far as I know, the trouble has not been found in the aircraft I flew.

On another occasion, Captain Wilson and myself made another test with the ARC-34, in which we took-off and flew in different directions at 35,000 feet. Upon reaching 200 nautical miles from starting point or 400 nautical miles between aircraft the communication became unsatisfactory. That is, the reception was generally too weak to be effective. However, at that distance (200 nautical miles) reception with the ground station was still good.

In summation, I feel that a radio that can give us innumerable channels on which to work (which is very important in GCI work when the area is saturated with aircrafts) and at the same time add less weight to an already extremely heavy fighter, is very desirable, and certainly a long step in the development of aircraft communications systems.

/s/ D. H. Trexler
D. H. TREXLER
Capt., USAF

C O P Y

C O P Y

OPERATIONS OFFICE
5TH FIGHTER-INTERCEPTOR SQUADRON
568TH AIR DEFENSE GROUP
McGuire Air Force Base
Trenton, New Jersey

4 November 1953

SUBJECT: ARC - 34 Project

TO: Project Officer
"Little Eva"

1. The undersigned and another pilot were assigned a maximum distance reception test on the ARC-34. After reaching an altitude of 35,000 feet and separated by some four-hundred twenty five nautical miles we were still able to receive each other's transmissions clearly and with enough strength to believe the distance between the aircrafts could have been increased to five-hundred nautical miles. At a distance of two-hundred five nautical miles from a certain ground station the reception was loud and clear.

2. Best feature of the ARC - 34 as expressed by this pilot is the ability to tune in any control tower, ground control approach and ground control intercept station that is desired.

3. This report on the ARC - 34 is flight characteristics in nature only. It is well to remember that the test was performed under clear VFR conditions.

/s/ Ralph W. Wilson
RALPH W. WILSON
Capt., USAF

C O P Y

C O P Y

2ND FIGHTER-INTERCEPTOR SQUADRON
McGUIRE AIR FORCE BASE
Trenton, New Jersey

3 November 1953

SUBJECT: ARC-34 Project

TO: Project Officer
"Little Eva"

As you requested, the following are my comments on the ARC-34 radio, based on my limited experience with it here in the squadron:

I've made approximately twelve flights in 86D's equipped with the ARC-34 radio. The sets performed exceptionally well under all circumstances. I was particularly impressed with the low level of background noise in the sets, which improved readability noticeably. Further, I have used the sets while parked in alert hangars and while taxiing around the air field without ever experiencing reception deadspots. On one occasion I had contact with a pilot flying over Niagara Falls AFB, a distance of almost 300 nautical miles from here.

/s/ W. E. Archbold
W. E. ARCHBOLD
Captain, USAF

C O P Y

C O P Y

ENGINEERING OFFICE
5TH FIGHTER-INTERCEPTOR SQUADRON
568TH AIR DEFENSE GROUP
McGUIRE AIR FORCE BASE
Trenton, New Jersey

3 November 1953

SUBJECT: ARC-34 Project

TO: Project Officer
"Little Eva"

1. Our experience with ARC-34 radios installed in aircraft in this Squadron have been very favorable.

2. Communications personnel have found the ARC-34 is easier to handle and maintain than previous radio installations. Setting up the frequencies is much easier and quicker. The ARC-34 does not require pressurization. Repair is easier because the components are more accessible. The test equipment provided with the radio simplifies trouble shooting by isolating troubles to various sub units. The interchangeability of various sub units and stages allow replacements to be made quickly at our level and their subsequent repair at higher echelons when our facilities are not adequate.

3. The airmen of the communications section have stated that they would rather maintain the ARC-34 than the present equipment.

/s/ Glenn F. Porter
GLENN F. PORTER
Captain, USAF
Materiel Officer

C O P Y

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C O P Y

ENGINEERING SECTION
2ND FIGHTER-INTERCEPTOR SQUADRON
568TH AIR DEFENSE GROUP
McGuire Air Force Base
Trenton, New Jersey

3 November 1953

SUBJECT: Arc-34 Project

TO: Project Officer
Little Eva

1. A review of the performance of this equipment since it was installed, points out favorable utilization for this section.
2. There are eleven (11) sets installed in F-86D Aircraft in this unit. The use of these sets has resulted in a far better aircraft utilization than was obtained prior to their use.
3. Making available the testing equipment that accompanied these sets permits Air Force operational units to accomplish their own maintenance as has been demonstrated by our use of these sets.

/s/ Max Becker
MAX BECKER
Capt, USAF
Engineering Officer

C O P Y

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APPENDIX I

Additional Photographs of
Radio Set AN/ARC-34

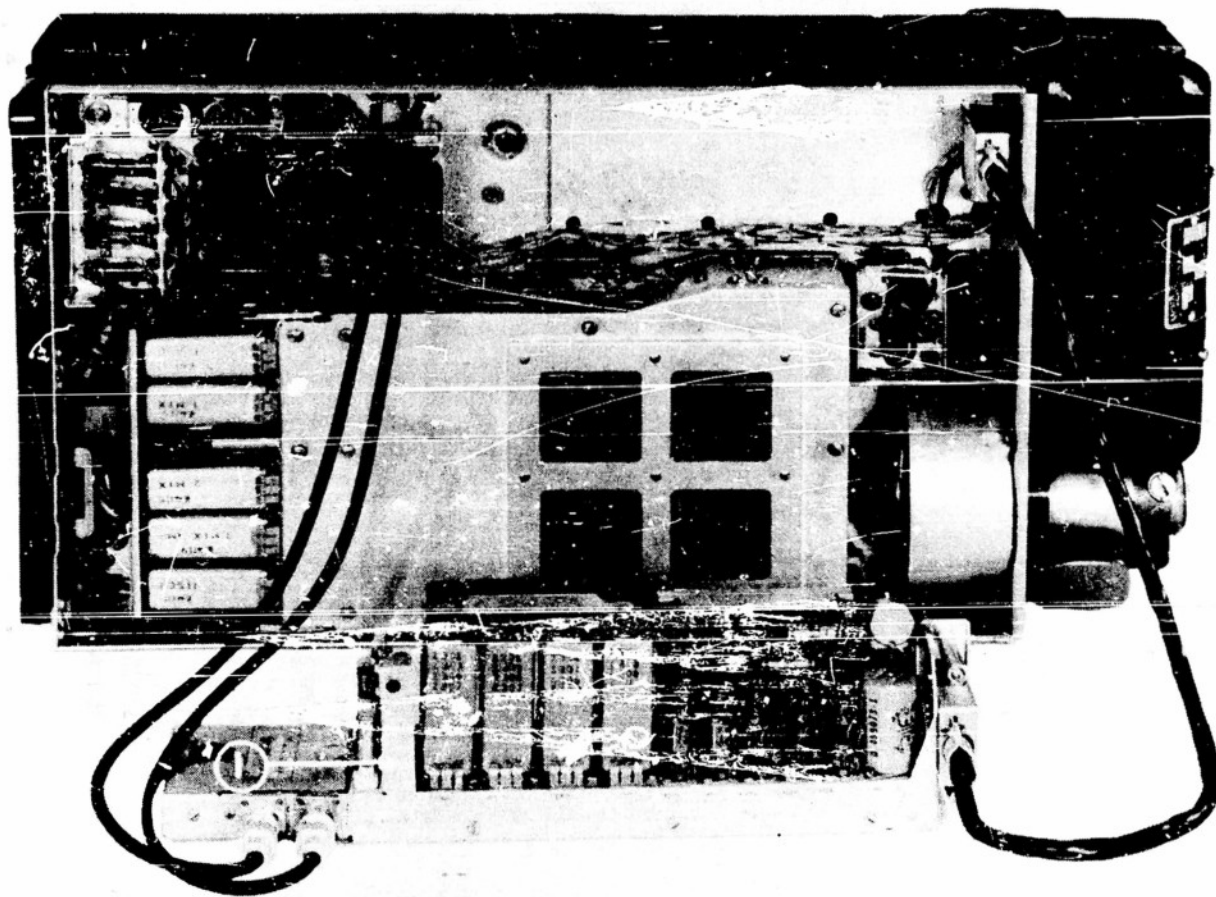


Fig. 8 BENCH TEST OF R-568/ARC-34

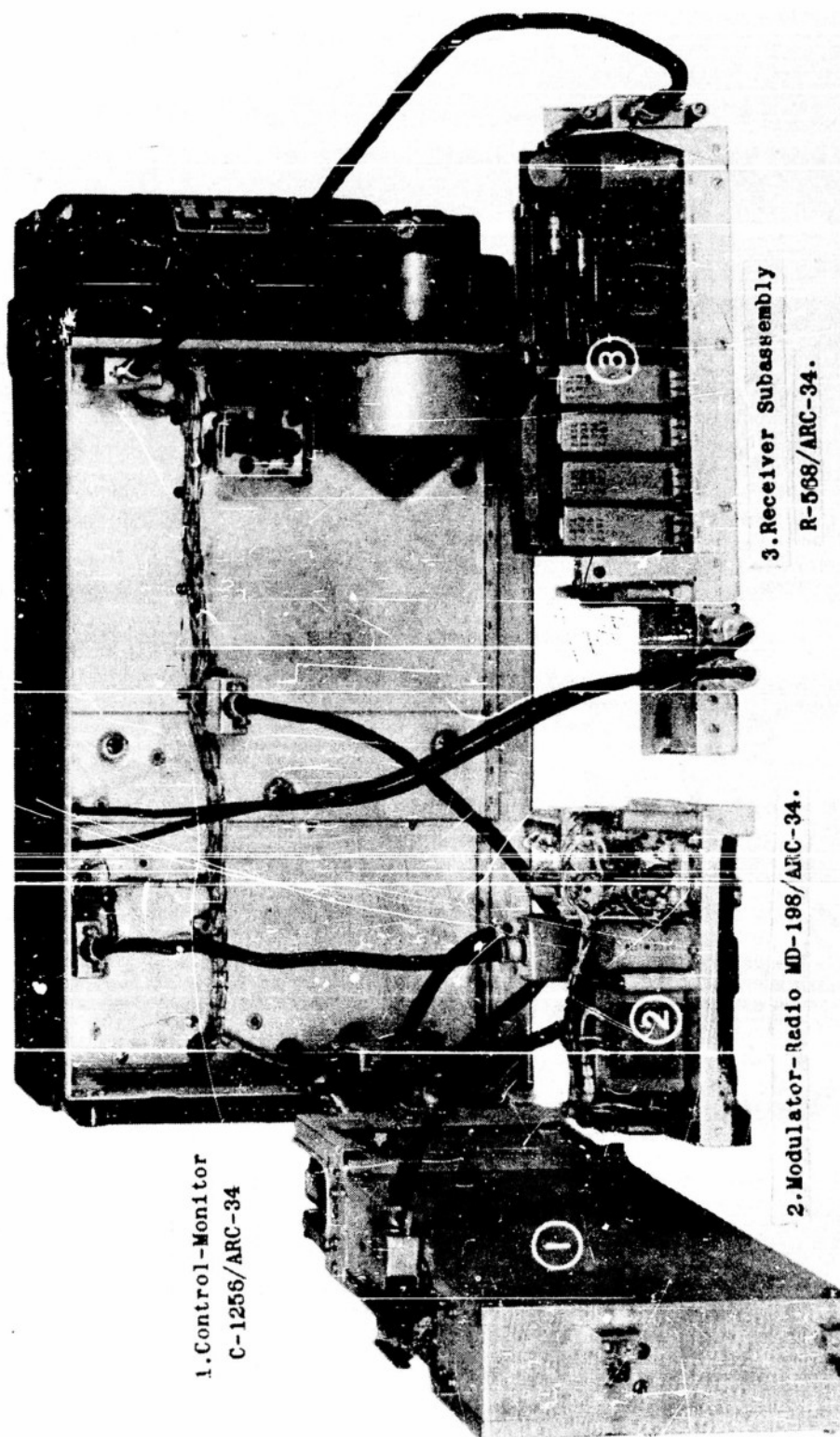


Fig. 9 BENCH TEST OF THREE AN/ARC-34 ASSEMBLIES

CABINET, ELECTRICAL EQUIPMENT
CY-1389/ARC-34

AMPLIFIER-OSCILLATOR
AM-868/ARC-34

CONTROL-MONITOR
C-1256/ARC-34

RECEIVER SUBASSEMBLY
R-568/ARC-34

MODULATOR-RADIO
MD-198/ARC-34

SELECTOR-CONTROL
SUBASSEMBLY
MX-1489/ARC-34

RECEIVER-RADIO
R-567/ARC-34

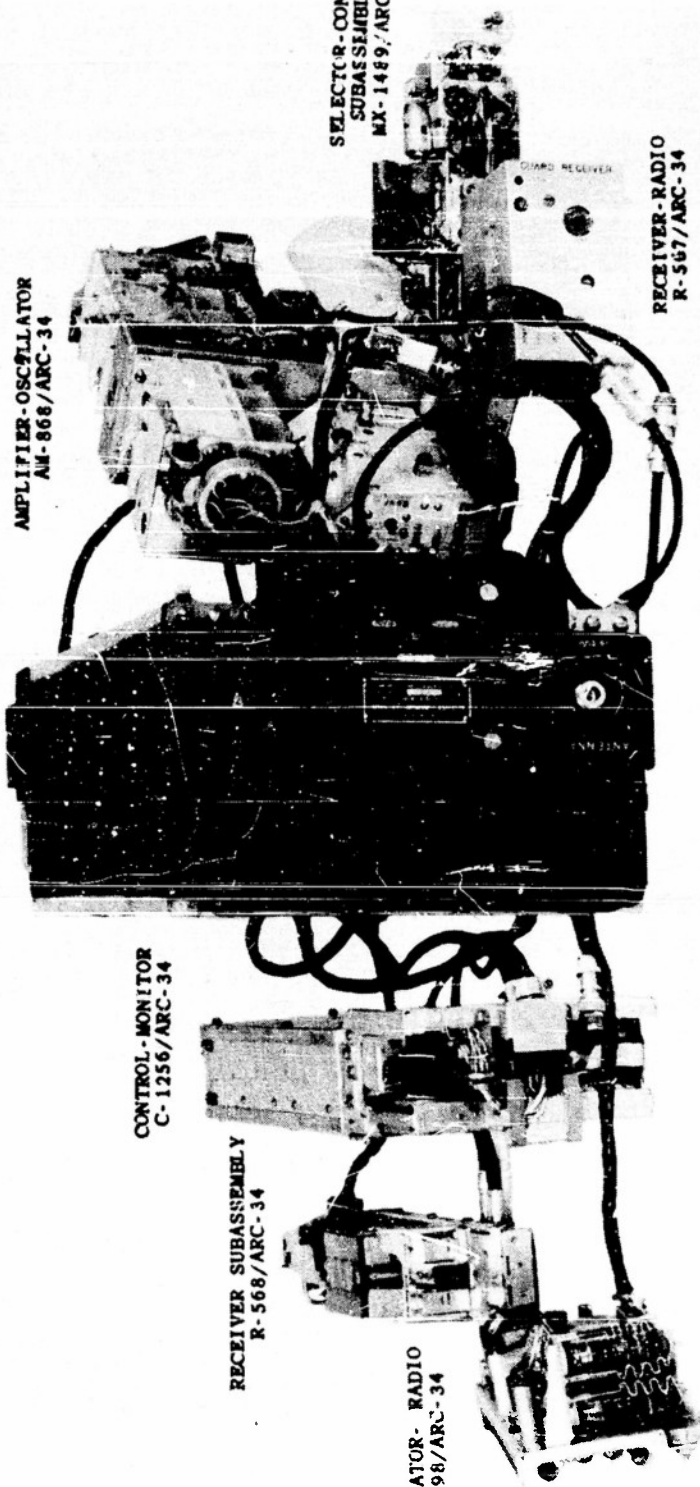


Fig. 16 RT-263/ARC-34 COMPLETELY PATCHED

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